MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2018/2019

EEM1026 – ENGINEERING MATHEMATICS II

(ME / TE / RE)

27 OCTOBER 2018

2.30 p.m. – 4.30 p.m.

(2 Hours)

INSTRUCTIONS TO STUDENTS:

1. This exam paper consists of 6 **pages** (including cover page) with 4 Questions only.
2. Attempt all the questions. All questions carry equal marks and the distribution of marks for each question is given.
2. Please write all your answers in the Answer Booklet provided. Show all relevant steps to obtain maximum marks.
3. Only NON-PROGRAMMABLE calculator is allowed.

Question 1

(a) By using the method of undetermined coefficients, solve the following inhomogeneous differential equation.

$$y'' - 2y' + y = 5e^{3x} + 4x$$

[11 marks]

(b) Consider the solution of $y'' - 4xy' + 2y = 0$ in the form of power series in x about $x_0 = 0$, i.e., $y = \sum_{n=0}^{\infty} c_n x^n$. Find the first six nonzero terms of this series solution. [14 marks]

Question 2

(a) A random sample of 80 van owners in the east coast of Peninsula Malaysia shows that a van owners is driven on average 1500 km/month with a standard deviation of 115 km. Assume the distribution of measurements to be approximately normal.
Based on this statement,

(i) Construct a 95% confidence interval for the average number of kilometres is driven monthly. [6 marks]

(ii) What will the conclusion of part (i) if the possible error of estimated average number of kilometres to be 1500 km/month? [1 mark]

(b) The average lifetime of batteries of a certain brand is 150 days. Does this indicate that the average lifetime of batteries is superior to the lifetime of a random sample of 9 batteries, which are 154, 159, 162, 142, 148, 149, 156, 153 and 146? Use a 0.01 level of significance and assume that the lifetime of batteries is normal distributed. [9 marks]

(c) Solve the following difference equation:

$$6y_{k+2} - 4y_{k+1} - 2y_k = 3 \quad ; \quad y_0 = 0, y_1 = 1.$$

[9 marks]

Continued...

Question 3

(a) Solve the following initial-value problem by Laplace transform

$$y'' + 2y' + y = e^{2t}, \quad y(0) = 0 \text{ and } y'(0) = 1.$$ [12 marks]

(b) Find the Fourier transform of

$$f(t) = \begin{cases} 1+t, & -1 \le t \le 0 \\ 1-t, & 0 \le t \le 1 \\ 0, & \textit{otherwise.} \end{cases}$$ [13 marks]

Question 4

(a) By method of separation of variables, solve the wave equation for the vibration of string stretched between the points $x = 0$ and $x = l$, which subject to following boundary condition.

PDE: $u_{xx} = \frac{1}{9} u_{tt}$

BCs: $u(0,t) = 0 \quad , \quad u(l,t) = 0 \quad$ for $t \ge 0$.

IC: $u_t(x,0) = 0 \quad$ for $0 \le x \le l$.

and $u(x,0) = f(x) = \begin{cases} x, & \text{for } 0 \le x \le \frac{1}{2} l \\ l - x, & \text{for } \frac{1}{2} l \le x \le l \end{cases}$

[20 marks]

(b) Discuss following equation is parabolic, hyperbolic or elliptic.

$$u_{xx} + 2u_{xy} + \alpha u_{tt} = 0$$

For various values of constant α. [5 marks]

Continued...

APPENDIX

Table I: Laplace transform for some of function $f(t)$

$f(t)$	$F(s) = \mathcal{L}\{f(t)\}$
1	$1/s$
t	$1/s^2$
$t^n (n = 1, 2, 3, \ldots)$	$n!/s^{n+1}$
e^{at}	$\dfrac{1}{s-a}$
te^{at}	$\dfrac{1}{(s-a)^2}$
$t^{n-1}e^{at}$	$\dfrac{(n-1)!}{(s-a)^n}$, $n = 1,2,\ldots\ldots$
$\cos at$	$\dfrac{s}{s^2+a^2}$
$\sin at$	$\dfrac{a}{s^2+a^2}$
$\cosh at$	$\dfrac{s}{s^2-a^2}$
$\sinh at$	$\dfrac{a}{s^2-a^2}$
$u(t - a)$	$\dfrac{e^{-as}}{s}$, $a \geq 0$
$f(t - a)\, u(t - a)$	$e^{-as}\, L(f)$
$f(t)\, \delta(t - a)$	$e^{-as} f(a)$
$f'(t)$	$s\mathcal{L}(f) - f(0)$
$f''(t)$	$s^2\mathcal{L}(f) - s\,f(0) - f'(0)$

Continued....

Table II: Table of Fourier Transform

$f(x)$	$F(w)=F\{f(x)\}=\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} f(x)e^{-iwx}dx$
$\frac{1}{x^2+a^2}\ (a>0)$	$\sqrt{\frac{\pi}{2}}\frac{e^{-a\|w\|}}{a}$
$H(x)\ e^{-ax}\ (\text{Re } a>0)$	$\frac{1}{\sqrt{2\pi}}\frac{1}{(a+iw)}$
$H(-x)\ e^{ax}\ (\text{Re } a>0)$	$\frac{1}{\sqrt{2\pi}}\frac{1}{(a-iw)}$
$e^{-a\|x\|}\ (a>0)$	$\frac{1}{\sqrt{2\pi}}\frac{2a}{(w^2+a^2)}$
e^{-x^2}	$\frac{1}{\sqrt{2}}e^{-\frac{w^2}{4}}$
$\frac{1}{2a\sqrt{\pi}}e^{-\frac{x^2}{(2a)^2}}\ (a>0)$	$\frac{1}{\sqrt{2\pi}}e^{-a^2w^2}$
$\frac{1}{\sqrt{\|x\|}}$	$\frac{1}{\sqrt{\|w\|}}$
$e^{-a\frac{\|x\|}{\sqrt{2}}}\sin\left(\frac{a}{\sqrt{2}}\|x\|+\frac{\pi}{4}\right)\ (a>0)$	$\frac{1}{\sqrt{2\pi}}\frac{2a^3}{(a^4+w^4)}$
$H(x+a)-H(x-a)$	$\frac{1}{\sqrt{2\pi}}\frac{2\sin aw}{w}$
$\delta(x-a)$	$\frac{1}{\sqrt{2\pi}}e^{-iaw}$

Continued….

Table III: Table of z- Transform.

$\{x_k\}$	$F(z)$
e^{-ak}	$\frac{z}{z-e^{-a}}$, $\lvert z\rvert > e^{-a}$
a^k	$\frac{z}{z-a}$, $\lvert z\rvert > \lvert a\rvert$
ka^k	$\frac{az}{(z-a)^2}$
k^2a^k	$\frac{az(z+a)}{(z-a)^3}$
$Z\{x_{k+1}\}$	$z\,Z\{x_k\} - zx_0$
$Z\{x_{k+2}\}$	$z^2\,Z\{x_k\} - z^2x_0 - zx_1$

End of paper.